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Mites of the Genera *Calcarmyobia* and *Pteracarus*
(Trombidiformes, Myobiidae) Parasitic on
Miniopterus (Chiroptera)

With 7 Text-figures

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ABSTRACT *Miniopterus* bat specimens deposited in the collection of the Muséum National d'Histoire Naturelle, Paris, France, and in Dr. K. MAEDA's collection were examined for myobiid mites. Three new African species of *Calcarmyobia* were found on them, and new locality records for 2 species of the genus were also obtained. A key to all the known species of *Calcarmyobia* was presented. *Pteracarus miniopteri* UCHIKAWA was newly recorded from Africa.

The bats of the genus *Miniopterus* are commonly infested with the mites of the genera *Calcarmyobia* RADFORD and *Pteracarus* JAMESON et CHOW. As the former mite genus has acquired an advanced speciation and the latter genus is rigidly conservative in the evolution, a set of the mites of both the genera on a *Miniopterus* may be prospective indicators in the deduction of its systematic situation. Recently, the mites of the genera occurring in the Oriental Region were properly recorded (FAIN & LUKOSCHUS, 1979, 1980; UCHIKAWA, 1976; UCHIKAWA *et al.*, 1980, and in press), and useful information on the taxonomy and phylogeny is gradually deduced from them. Thus, the clarification of the mites of the world scale is desirable for both acarology and chiropterology.

The present author was fortunately allowed to examine *Miniopterus* bats deposited in the collection of the Muséum National d'Histoire Naturelle, Paris, France, for parasitic mites. Dr. Kishio MAEDA generously provided the author with a pair of the male and female skin specimens of *Miniopterus inflatus* from Kenya for inspection of parasites. These specimens yielded interesting information on European and African mites as well as those of the other regions as recorded below.

MITES OF THE GENUS *Calcarmyobia*

The type-species, *Calcarmyobia rhinolophia* (RADFORD), was recorded as being

parasitic on *Rhinolophus lobatus* from Kapretwa, Mt. Elgon, Kenya (RADFORD, 1940). However, the mites of the genus are specific to the bats of the genus *Miniopterus*. Accordingly, *Rhinolophus lobatus* must be erroneously allocated as the type host of the mite. FAIN (1978) designated the lectotype female and allolectotype male of *C. rhinolophia* and presented the redescription of both the sexes. He also identified a male, 2 females and a nymph taken from *Miniopterus inflatus* in Zaire with *C. rhinolophia* in the same paper.

The present author found a *Calcarmyobia* on *Miniopterus* from Congo, *M. inflatus* from Zaire and on *Miniopterus (inflatus?)*, data uncertain, deposited in the Muséum National d'Histoire Naturelle, Paris. Another *Calcarmyobia* was recovered from *M. inflatus* in Dr. MAEDA's collection, which had been caught in Kakamega Forest, West Kenya, by J. G. WILLIAMS. As a result of comparison of these 2 forms of *Calcarmyobia* with the lectotype and allolectotype of *C. rhinolophia*, the author failed to identify either of them with *C. rhinolophia*.

The mites of the genus *Calcarmyobia* are morphologically close to each other. The minor, but distinct morphological properties, which serve as criteria for differentiating species, were presented only recently (UCHIKAWA, 1976; UCHIKAWA *et al.*, 1980; FAIN & LUKOSCHUS, 1979, 1980). The structure of the genital shield, nature of d_1 and d_2 close to the genital shield and claws on leg II are the most important characteristics for separating the males. The specific morphological properties for the females are sparse, but nature of setae on genito-anal region may be taken as key characteristics. Some other supplementary properties can be occasionally found in either sex of the mites.

Based on the above criteria, the two aforementioned, African forms were regarded as being distinctive. Moreover, a *Calcarmyobia* found on *M. manavi* from the Comores Islands was proved to represent another new species. A key to the 8 species so far known, inclusive of the present 3 new species, is given below.

KEY TO MALES OF *Calcarmyobia*¹⁾

1. Genital shield large, about 70 μ m long. Claws on leg II simple.....*C. kenyaensis* sp. n.
- Genital shield less than 60 μ m in length. One claw on leg II modified..... 2
2. Genital setae *gm* lacking..... 3
- Genital setae *gm* present..... 5
3. Setae d_2 inflated and abruptly terminating. One claw on leg II with a prominent hook at basal third.....*C. hamata* UCHIKAWA *et al.*
- Setae d_2 thick and gradually tapering. One claw on leg II swollen and with a minute process at apical fourth..... 4
4. Genital shield longer than wide. Setae *vi* swollen posteriorly.....*C. miniopterus* (WOMERSLEY)

1) The setal nomenclature is given in Figs. 1 and 5A.

- Genital shield almost as long as wide. Setae *vi* smoothly tapering.....
.....*C. australasiae* FAIN et LUKOSCHUS
- 5. Genital setae *gm* spiniform. Setae *d*₁ rather flat...?*C. parenzani* LOMBARDINI
- Genital setae *gm* setiform. Setae *d*₁ setiform..... 6
- 6. Posterior lobes of genital shield membranous. Genital setae *gp* inconspicuous
or probably lacking. Seta *d*₁ with notched tip*C. comoresensis* sp. n.
- Posterior lobes of genital shield well chitinized. Genital setae *gp* conspicuous.
Seta *d*₁ with pointed tip..... 7
- 7. Genital shield of flight of 5 steps. Genital setae *gp* inflated. Setae *d*₁ and *d*₂
equal in size.....*C. rhinolophia* (RADFORD)
- Genital shield of flight of 4 steps. Genital setae *gp* setiform. Setae *d*₁ slightly
smaller than *d*₂.....*C. congoensis* sp. n.

KEY TO FEMALES OF *Calcarmyobia*²⁾

- 1. Opisthosomal scales present..... 2
- Opisthosomal scales lacking..... 3
- 2. Opisthosomal scales on dorsal surface.....*C. hamata* UCHIKAWA et al.
- Opisthosomal scales on lateral margins.....*C. miniopteris* (WOMERSLEY)
- 3. Seta *d*₁ terminating abruptly, its membranous tail being shorter than proximal
striated part. 4
- Seta *d*₁ tapering, its membranous tail as long as proximal striated part 5
- 4. Anal setae *ai* normal. Genital setae *g*₅ longer than *g*₇.....
.....?*C. parenzani* LOMBARDINI
- Anal setae *ai* clavate. Genital setae *g*₅ shorter than *g*₇.....
.....*C. australasiae* FAIN et LUKOSCHUS
- 5. Setae *d*₃ situated slightly anteriorad from basal level of *l*₂. Anal setae *ai* cylin-
drical. 6
- Setae *d*₃ situated on or slightly posteriorad from basal level of *l*₂. Anal setae *ai*
peg-like. 7
- 6. Anal setae *ai* 6 μ m long. Genital setae *g*₇ 5 μ m wide at base.....
.....*C. rhinolophia* (RADFORD)
- Anal setae *ai* 4 μ m long. Genital setae *g*₇ 3 μ m wide at base.....
.....*C. congoensis* sp. n.
- 7. Anal setae *ai* round apically and about 4 μ m long.....*C. kenyaensis* sp. n.
- Anal setae *ai* weakly narrowed apically, and about 6 μ m long.....
.....*C. comoresensis* sp. n.

Calcarmyobia rhinolophia (RADFORD) was redescribed by FAIN (1978), and its important morphological characteristics were also depicted in FAIN and LUKOSCHUS (1979). It is not necessary to add any morphological account to his redescription, but some figures and measurements will be given below for comparison of this species

2) The setal nomenclature is given in Figs. 1 and 6A.

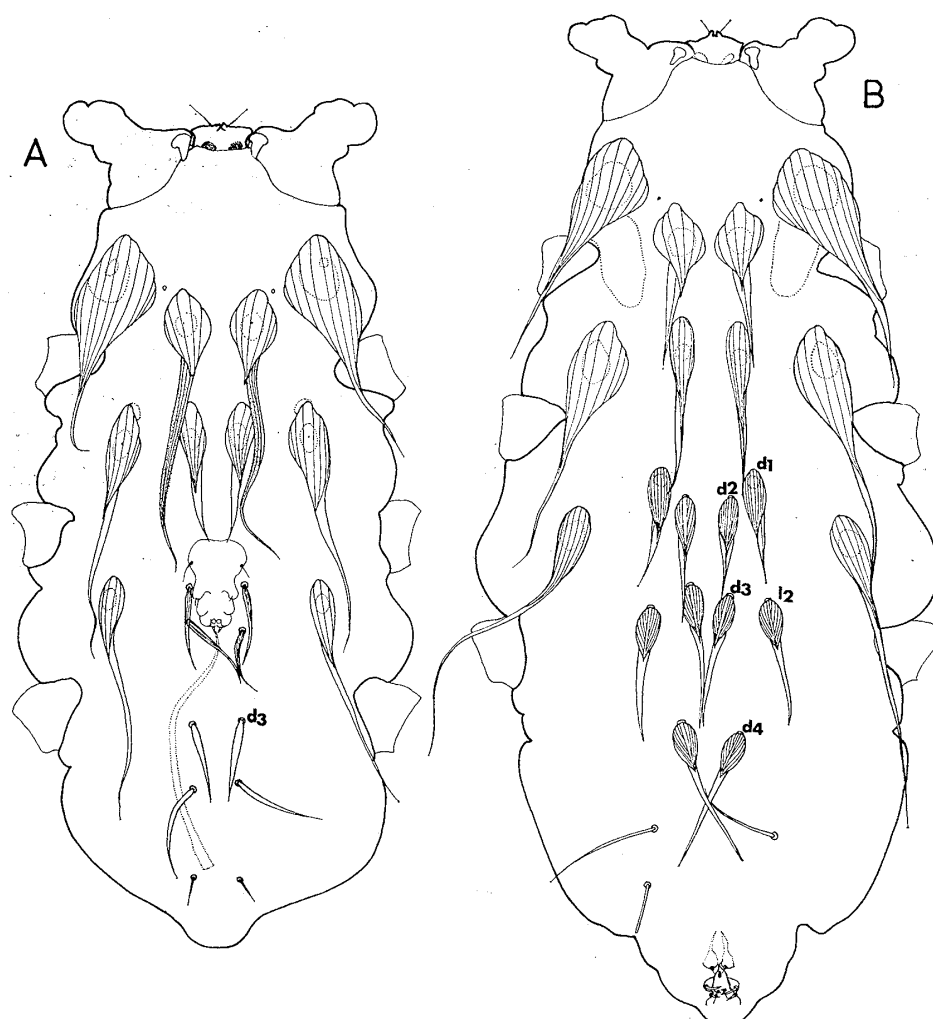


Fig. 1. *Calcarmyobia rhinolophia* (RADFORD), allectotype male (A) and lectotype female (B).

with the successive new ones.

All the specimens including those of new and anonymous species examined in the present study were as follows:

1. ?*Calcarmyobia parenzani* LOMBARDINI, 1956

Material examined. One ♂, 2 ♀♀, ex *Miniopterus schreibersii*, Sanesa near Tetouan, Morocco, 1904 (in Mus. Hist. Nat., Paris, 1908–30); 1 ♂, 2 ♀♀, ex *Miniopterus schreibersii*, Algeria (in Mus. Hist. Nat., Paris, 1884–2022); 1 ♂, ex *Miniopterus schreibersii*, Lebanon (in Mus. Hist. Nat., Paris, 1876–337); 4 ♂♂, 1 nymph, ex *Miniopterus schreibersii*, Iran (in Mus. Hist. Nat., Paris 1904–1638).

2. *Calcarmyobia australasiae* FAIN et LUKOSCHUS, 1980

Material examined. Two ♂♂, 1 ♀, ex *Miniopterus poululus*, Dolores, Luzon, Philippines (labelled *M. schreibersii* in Mus. Hist. Nat., Paris, 1880–2446–2470).

3. *Calcarmyobia congoensis* sp. n.

(Figs. 2, 5B, 6B)

Male (Figs. 2 A and 5 B). Setae *vi* reaching basal level of *ga*, with granular tail. Genital shield of flight of 4 steps; *gp* conspicuous but setiform. Seta *d*₁ with pointed tip, slightly slenderer than *d*₂. A claw on leg II modified. Measurements as in Table 1.

Female (Figs. 2 B and 6 B). Dorsal setae situated slightly anteriad from basal level of *l*₂. Setae *sc i* and *l*₁ rather slender. Anal setae *ai* cylindrical, and 4 μ m long. Genital setae *g*₁ relatively slender. Measurements as in Table 2.

Material examined. Holotype male and allotype female, ex *Miniopterus*, Groth Biala-Kouanga (near Sibiti), Congo (in Mus. Hist. Nat., Paris, 26-05-69); 2 ♂♂, ex *Miniopterus inflatus*, Katanga, Zaire, 1956 (in Mus. Hist. Nat., Paris, C 1957-127); 1 ♂, 1 ♀, ex *Miniopterus (inflatus ?)*, data uncertain (in Mus. Hist. Nat., Paris).

The holotype and allotype will be deposited in the collection of the National Science Museum (Nat. Hist.), Tokyo, Japan.

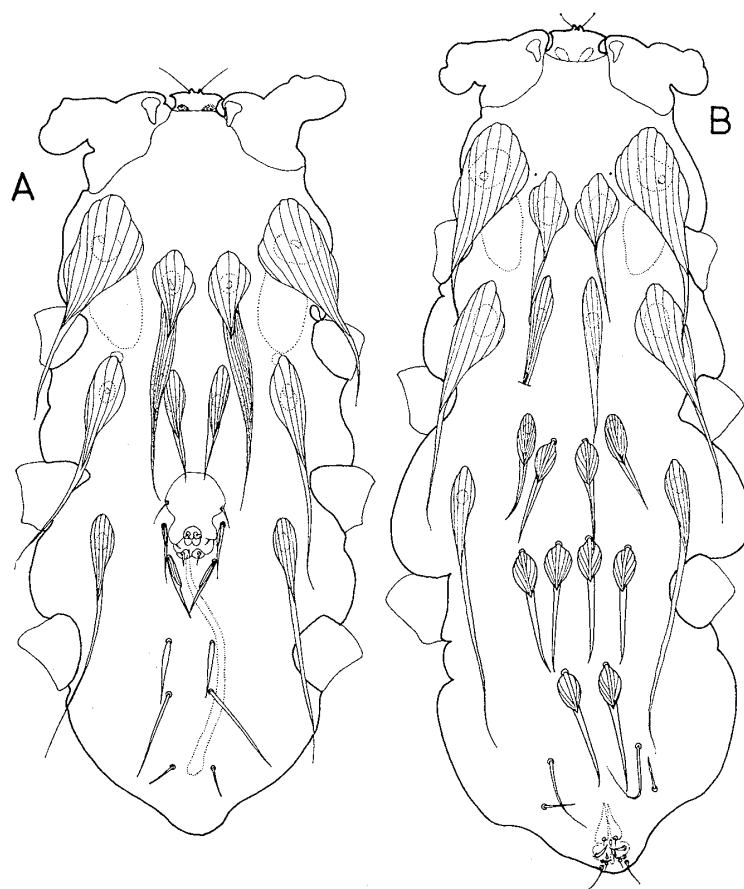


Fig. 2. *Calcarmyobia congoensis* sp. n., holotype male (A) and allotype female (B).

Table 1
Measurements for males of *Calcarmyobia* (μm).

	<i>C. rhinolophia</i> (Allolectotype)	<i>C. congoensis</i> (n=3)	<i>C. kenyaensis</i> (n=4)	<i>C. comoresensis</i> (Holotype)
Body length	510	450–500	480–490	470
Body width	240	190–210	200–210	220
Length of genital shield	58	53– 53	70– 72	60
Width of genital shield	38	38– 40	42– 45	50
<i>ga</i>	16	12– 16	18– 20	16
<i>gm</i>	6	5– 6	8– 8	9
<i>gp</i>	12	7– 8	10	—
<i>d</i> ₁	45	40– 43	40– 45	33
<i>d</i> ₂	45	40– 43	44– 53	50

Table 2
Measurements for females of *Calcarmyobia* (μm).

	<i>C. rhinolophia</i> (Lectotype)	<i>C. congoensis</i> (n=2)	<i>C. kenyaensis</i> (n=2)	<i>C. comoresensis</i> (n=3)
Body length	625	560–600	530–580	580–590
Body width	295	240–265	240–260	258–283
<i>ve</i>	158 (50)*	155–168 (48–48)*	160–170 (48–52)*	160–165 (50–52)*
<i>vi</i>	110 (35)	98–103 (32–33)	108 (35–35)	100–110 (30–35)
<i>sc e</i>	175 (35)	170–180 (33–33)	190 (32–35)	182–193 (35–38)
<i>sc i</i>	110 (18)	103–105 (15–15)	110–115 (15–17)	110–118 (18–18)
<i>d</i> ₁	75 (16)	70– 73 (18–18)	73– 83 (15–18)	65– 73 (15–18)
<i>d</i> ₂	78 (15)	70– 73 (17–18)	70– 75 (15–15)	75– 80 (15–18)
<i>d</i> ₃	85 (15)	75– 83 (18–18)	84– 85 (15–15)	88– 95 (16–18)
<i>d</i> ₄	90 (16)	83– 85 (18–18)	89– 91 (15–15)	88– 95 (16–18)
<i>l</i> ₁	205 (23)	190–190 (18–18)	205–215 (23–23)	185–191 (23–23)
<i>l</i> ₂	85 (15)	75– 78 (18–18)	80– 83 (15–15)	80– 90 (15–17)
<i>l</i> ₃	75	?– 70	83– 85	90
<i>l</i> ₄	23	23– 23	25– 28	28– 30
<i>ai</i>	6	4– 4	4– 5	6– 6

* Figures in parentheses show maximum width.

4. *Calcarmyobia kenyaensis* sp. n.

(Figs. 3, 5C, 6C)

Male (Figs. 3 A and 5 C). Setae *vi* not reaching level of *ga*; granulets on tail sparse. Genital shield large, about 70 μm in length; second lobes of genital shield prominently projecting laterally; posterior lobes adhering to each other. (The observation was based on the dry specimens found on the skin specimens. Some irreversible deformation may possibly occur on the posterior part of the genital shield due to desiccation.) Genital setae *gm* and *gp* setiform. Setae *d*₁ with pointed tips stout, but distinctly shorter than *d*₂. Both claws on leg II normal, that is, neither of them swollen and/or hooked. Measurements as in Table 1.

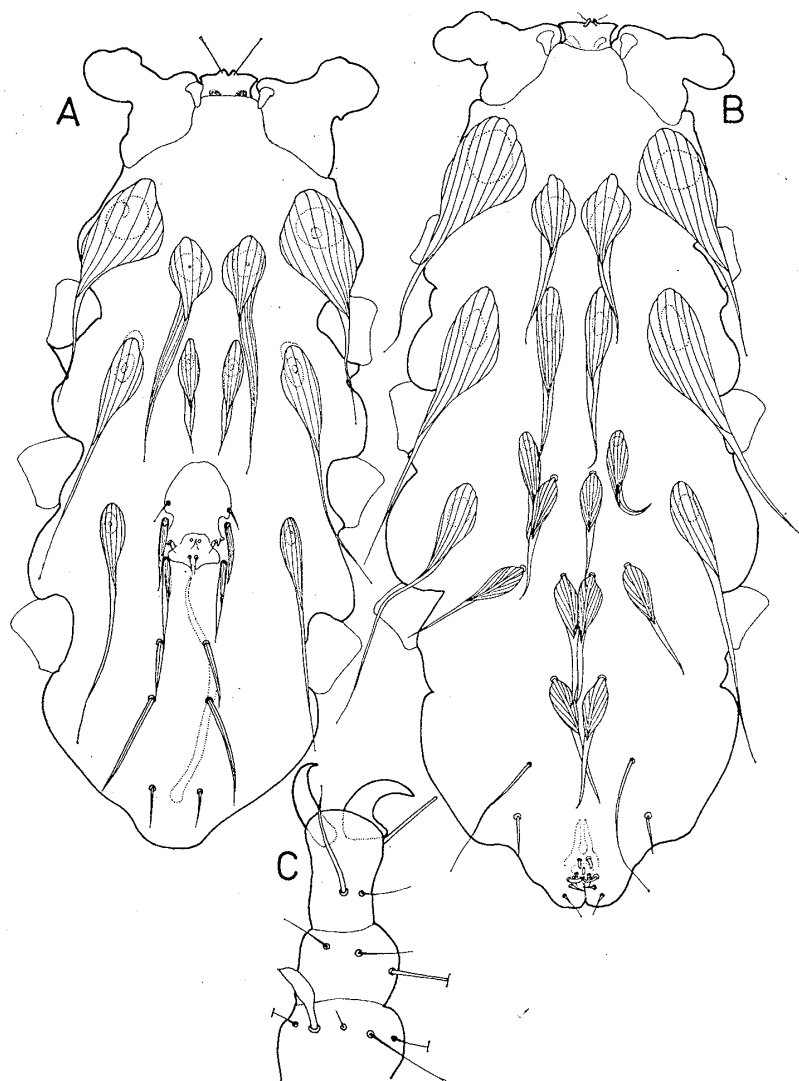


Fig. 3. *Calcarmyobia kenyaensis* sp. n., holotype male (A), allotype female (B) and leg II of holotype male (C).

Female (Figs. 3 B and 6 C). Setae d_1 tapering gradually; striated basal part as long as tail. Setae d_3 situated almost on or slightly posterior to basal level of l_2 . Anal setae ai clavate and round apically. Genital setae g_7 well developed, blade-shaped. Measurements as in Table 2.

Material examined. Holotype male, allotype female, a pair of male and female paratypes and a nymph, ex *Miniopterus inflatus*, Kakamega Forest, West Kenya, 30-I-1971 (in Dr. MAEDA's collection); 2 male paratypes and 2 nymphs from the same host and locality, 24-I-1971 (in Dr. MAEDA's collection).

The holotype and allotype will be deposited in the collection of the National Science Museum (Nat. Hist.), Tokyo, and the other specimens are deposited in the collection of the author.

5. *Calcarmyobia comoresensis* sp. n.

(Figs. 4, 5D, 6D)

Male (Figs. 4 A and 5 D). Setae *vi* reaching level of *ga*, with smooth tail. Genital shield slightly longer than wide; posterior lobes of the shield membranous; setae *ga* conspicuous but *gp* probably lacking. Setae *d*₁ with notched tips, and slenderer than *d*₂. Setae *d*₃ rather flat. Measurements as in Table 1.

Female (Figs. 4 B and 6 D). Setae *d*₁ tapering gradually; striated proximal part subequal in length to tail. Setae *d*₃ situated on or slightly posterior to basal level of *l*₂. Anal setae *ai* swollen and slightly narrowed apically. Genital setae *g*₇ stout.

Material examined. Holotype male, allotype female, 2 paratype females and a nymph, ex *Miniopterus manavi*, Comores Islands, 26-XII-1889 (in Mus. Hist. Nat., Paris).

The allotype female will be deposited in the collection of the National Science

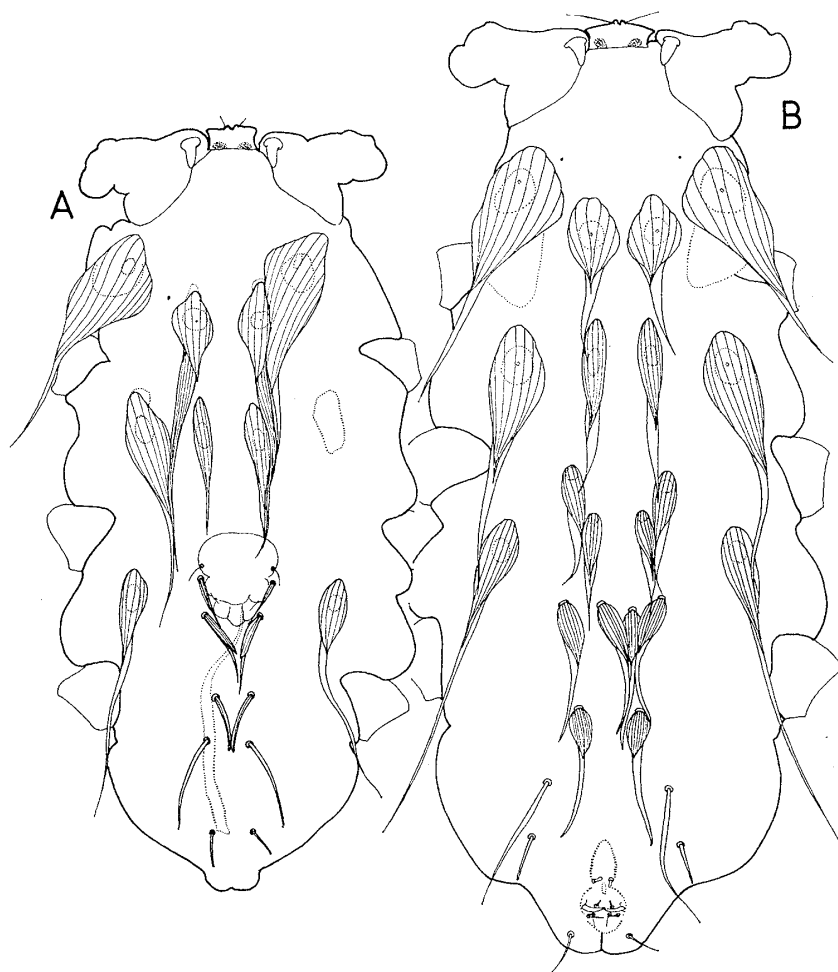


Fig. 4. *Calcarmyobia comoresensis* sp. n., holotype male (A) and allotype female (B).

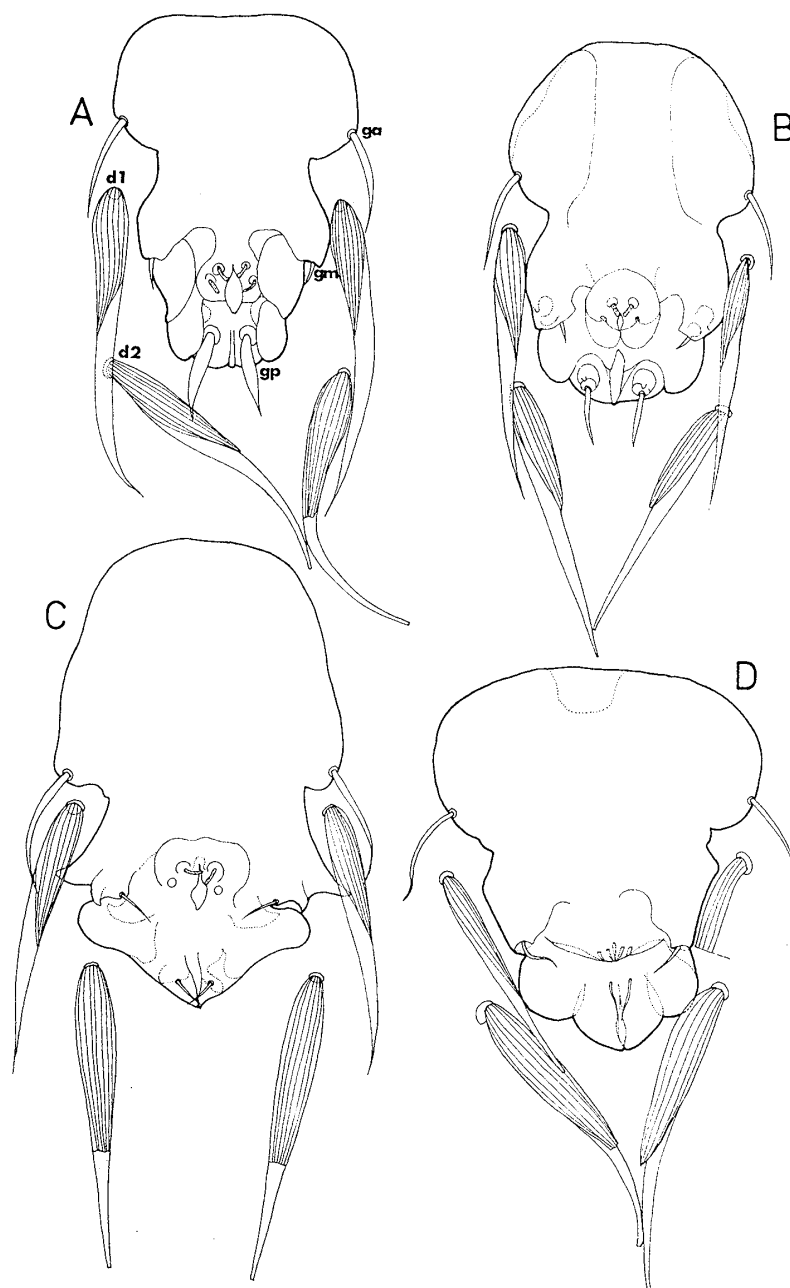


Fig. 5. Genital shield; A, *Calcarmyobia rhinolophia* (RADFORD); B, *Calcarmyobia congoensis* sp. n.; C, *Calcarmyobia kenyaensis* sp. n.; D, *Calcarmyobia comoresensis* sp. n. (in the same scale).

Museum (Nat. Hist.), Tokyo, and the other specimens are deposited in the collection of the author.

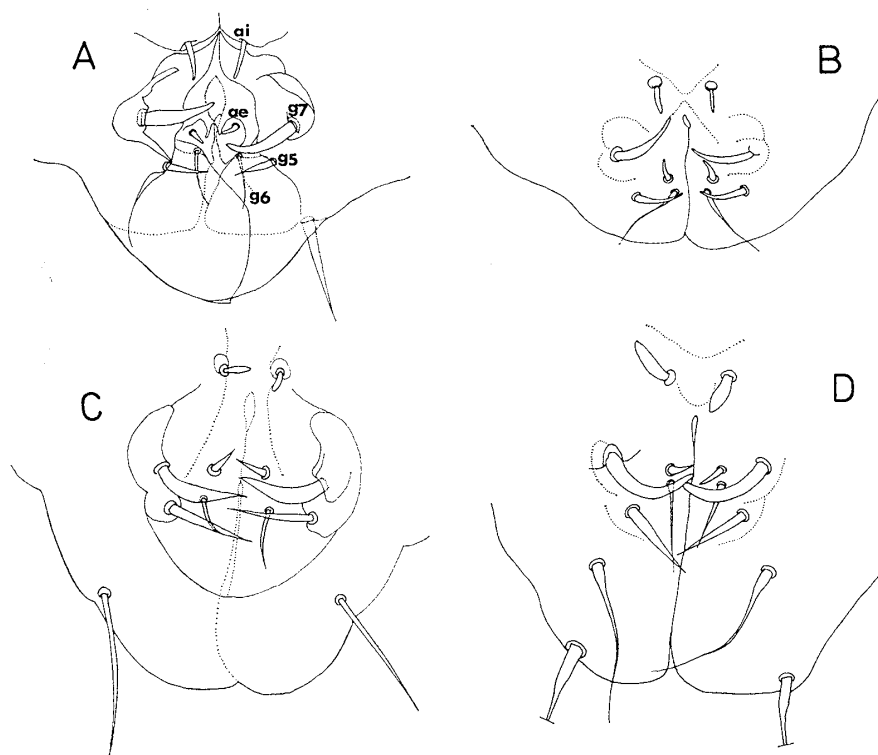


Fig. 6. Female genito-anal region; A, *Calcarmyobia rhinolophia* (RADFORD); B, *Calcarmyobia congoensis* sp. n.; C, *Calcarmyobia kenyaensis* sp. n.; D, *Calcarmyobia comoresensis* sp. n. (in the same scale).

6. *Calcarmyobia* sp. nr. *kenyaensis*

A badly damaged male and 4 females were taken from 5 specimens of the bats labelled *Miniopterus scotinus* SUNDEVALL from Madagascar (1912–44) and deposited in the collection of the Muséum National d'Histoire Naturelle, Paris. The male specimen only reveals that the claws on leg II are close to those of *C. comoresensis* sp. n. and that the setae *gm* are setiform. On the other hand, the female keys out in couplet 7 and further goes to *C. comoresensis* in the above key. However, more male specimens are necessary for the identification of this species.

7. *Calcarmyobia* sp.

Three females were taken from the bat labelled *Miniopterus schreibersii blepotis* from India and deposited in the collection of the Muséum National d'Histoire Naturelle, Paris.³⁾ This mite goes to couplet 5 in the above key. The setae *d*₃

3) Dr. K. MAEDA, who had formerly examined this specimen in the museum, personally communicated to the author that morphology and origin of the specimen should be carefully re-examined.

are situated on basal level of I_2 , though anal setae *ai* are cylindrical. Thus, the mite probably represents a hitherto unknown species.

HOSTS AND DISTRIBUTION OF *Calcarmyobia*

The records of the mites of *Calcarmyobia* from Australia, the Oriental Region and Japan (FAIN & LUKOSCHUS, 1979, 1980; UCHIKAWA, 1976; UCHIKAWA *et al.*, 1980 and in print) suggest that any mite is not host species specific but is usually shared by two or more species of bats. Accordingly, the bats sharing a mite are regarded as being phylogenetically close to each other. This is a good guide in the classification and phylogeny of the host bat *Miniopterus*. Data of the hosts and distribution of all the known species are presented in Table 3 and Fig. 7.

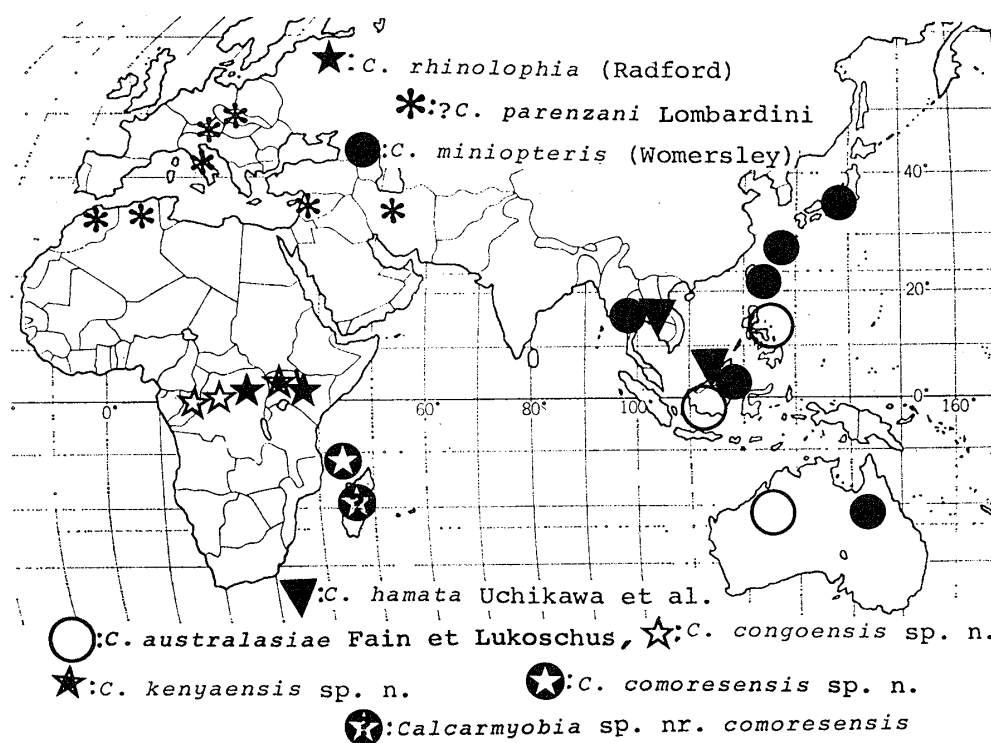
MITES OF THE GENUS *Pteracarus*

Only the two species of the mites, *Pteracarus faini* UCHIKAWA and *Pteracarus miniopteri* UCHIKAWA, have so far been known to occur on the bats of the genus *Miniopterus*. *P. miniopteri* was recorded from African bats in the present study.

Table 3
Host and distribution of *Calcarmyobia*.

Mite species	Host species	Locality
<i>C. rhinolophia</i> (RADFORD)	<i>Rh. lobatus</i>	Kenya ¹⁾
	<i>M. inflatus</i>	Zaire ²⁾
? <i>C. parenzani</i> LOMBARDINI	Bat	Italy ³⁾
	<i>M. schreibersii</i>	Europe ⁴⁾ , Morocco*
		Algeria*, Lebanon*, Iran*
<i>C. miniopteri</i> (WOMERSLEY)	<i>M. schreibersii</i>	Australia ⁵⁾ , ⁶⁾ , Thailand ⁸⁾
		Taiwan*, Japan ⁹⁾
	<i>Miniopterus</i> sp.	Japan
	<i>M. magnater</i>	Borneo ⁷⁾
<i>C. hamata</i> UCHIKAWA <i>et al.</i>	<i>M. schreibersii</i>	Borneo ⁷⁾
	<i>M. medius</i>	Thailand ⁸⁾
<i>C. australasiae</i> FAIN <i>et</i> LUKOSCHUS	<i>M. australis</i>	Australia ¹⁰⁾ , Borneo ⁷⁾ , Thailand ⁸⁾
	<i>M. poululus</i>	Philippines*
<i>C. congoensis</i> sp. n.	<i>M. inflatus</i>	Congo*
	<i>Miniopterus</i> sp.	Zaire*
<i>C. kenyaensis</i> sp. n.	<i>M. inflatus</i>	Kenya*
<i>C. comoresensis</i> sp. n.	<i>M. manavi</i>	Comores Islands*
<i>Calcarmyobia</i> sp. nr. <i>comoresensis</i>	<i>M. scotinus</i>	Madagascar*
<i>Calcarmyobia</i> sp.	<i>M. schreibersii blepotis</i>	India*

1) RADFORD, 1940; 2) FAIN, 1978; 3) In FAIN & LUKOSCHUS, 1979, 1980; FAIN & AELLEN, 1979; 4) DUSBÁBEK, 1963; 5) WOMERSLEY, 1941; 6) FAIN & LUKOSCHUS, 1979; 7) UCHIKAWA *et al.*, 1980; 8) UCHIKAWA *et al.*, in press; 9) UCHIKAWA, 1976; 10) FAIN & LUKOSCHUS, 1980; *: New record.

Fig. 7. Distribution of *Calcarmyobia* spp.1. *Pteracarus miniopteri* UCHIKAWA

Material examined. Three ♂♂, 5 ♀♀, ex *Miniopterus manavi*, Comores Islands (in Mus Hist. Nat., Paris, 1889–12–26); 5 ♂♂, ex *Miniopterus inflatus*, Kakamega Forest, West Kenya (from Dr. MAEDA's collection).

The host and locality records of the two species are given in Table 4.

Table 4

Host and distribution of *Pteracarus* parasitic on *Miniopterus*.

Mite species	Host species	Locality
<i>P. faini</i> UCHIKAWA	<i>Miniopterus schreibersii</i>	Japan ¹⁾ , Taiwan*
	<i>Miniopterus australis</i>	Thailand ²⁾ , Borneo ³⁾
	<i>Miniopterus magnater</i>	Borneo ³⁾
<i>P. miniopteri</i> UCHIKAWA	<i>Miniopterus schreibersii</i>	Europe ⁴⁾ , Borneo ³⁾
	<i>Miniopterus medius</i>	Thailand ²⁾
	<i>Miniopterus manavi</i>	Comores Islands*
	<i>Miniopterus inflatus</i>	Kenya*

1) UCHIKAWA, 1978 a; 2) UCHIKAWA *et al.*, in press; 3) UCHIKAWA *et al.*, 1980; 4) UCHIKAWA, 1978 b; *: New record.

DISCUSSION

Morphological study of *Calcarmyobia rhinolophia* has been repeatedly made, but its real host is not yet confirmed. As shown in Table 3, all the known hosts of *Calcarmyobia* mites except for *Rhinolophus lobatus* are the bats of the genus *Miniopterus*. It is, thus, reasonable to presume that any *Rhinolophus* bat cannot be a natural host of *Calcarmyobia*. Mt. Elgon, the type-locality of *C. rhinolophia*, is rather close to Kakamega Forest, the locality of *M. inflatus* examined in the present study. This bat was, however, not a host of *C. rhinolophia* in the forest. The author is consequently forced to presume that no less than 2 valid species of the bats of the genus *Miniopterus* must be distributed in West Kenya as the hosts of *C. rhinolophia* and *C. kenyaensis* sp. n. The same is also the case in Zaire where *C. rhinolophia* and *C. congoensis* sp. n. have been recorded (Table 3).

The bats of the genus *Miniopterus* have been examined extensively in Europe and in the Oriental Region. It is proved that a bat is usually infested with a single species of the mite of the genus *Calcarmyobia*. In Table 3, however, there are a few species of the bats that are recorded as the hosts of 2 or more species of the mites. *M. inflatus* is, for example, so far regarded as the host of 3 mites, and *M. schreibersii* as the host of 4 mites. This does not suggest a possibility of synhospitality of *Calcarmyobia* mites on a host, but merely reflects ambiguity in the classification of such host species. It was already pointed out that the European and Japanese bats called by the same name *M. schreibersii* and infested with respective mites should be regarded as being fully different species (UCHIKAWA & HARADA, 1981). As suggested in Fig. 3, *M. schreibersii* and/or its close relatives are distributed in circum-Mediterranean Regions at least east to Iran. Besides, *Miniopterus* bats seem to have advanced speciation in both tropical Africa and the Oriental Region. It is certain that the thus far proposed systematics of *Miniopterus* will be greatly improved with the aid of information on the mites of the genus *Calcarmyobia* parasitic on them.

The mites of the genus *Pteracarus* are much more catholic in host preference than the mites of the genus *Calcarmyobia*, which are specific to the bats of the genus *Miniopterus*. Either of the known species occurring on *Miniopterus* is shared by several forms of the bats named properly or not as shown in Table 4. The hosts of a mite are considered to be phylogenetically closer to each other than to a group of hosts that harbour another mite. Both the two species of the mites have been recorded from the Oriental Region, but *P. faini* has never been found so far in Africa. When the mites of the genus *Pteracarus* parasitic on *Miniopterus* bats and their distribution pattern are thoroughly clarified, persuasive information on the classification and phylogeny of the host bats will be deduced from such purely parasitological data.

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